REMARKS

Reconsideration of the above-identified patent application is respectfully requested. Claims 21-28, of which only claim 21 is independent, are presented for examination. By means of the present Amendment, claim 21 has been amended in order to overcome the Final Rejection of March 30, 2004.

In the Final Rejection dated March 30, 2004, the Examiner rejected claims 21-26 under 35 U.S.C. 103(a) as being unpatentable over EP 0,149,247 (EP '247) in view of JP 08-117,823 A(JP '823A). The Examiner further rejected claims 27 and 28 under 35 U.S.C. 103(a) as being unpatentable over EP '247 in view of JP '823A, and further in view of US 3,535,204 (US '204). According to the Examiner, EP '247 discloses a roll stand comprising a pair of work rolls (43) for rolling a metal strip, back up rolls (49), a track with support or intermediate rolls, wherein the track is slidable into and out of the roll stand along a longitudinal direction of the track, wherein the intermediate roll supports the work rolls in a direction perpendicular to the rolled strip, and wherein the back up rolls are retracted in order to facilitate chock/roll removal and replacement. The Examiner conceded that EP '247 lacks a support beam with a plurality of individually adjustable force generation devices arranged between a support beam and the back up roll that presses the back up roll in order to provide a bending force. However, the Examiner cited JP '823A as disclosing a plurality of force generation devices, wherein these devices are arranged along the back up roll, wherein they act between the back up roll and the stand housing, which necessarily requires support beams, and wherein these

devices provide "crown control" or bending control. Thus, according to the Examiner, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the rolling mill taught by EP '247 with a plurality of force generation devices and control mechanism in order to allow for the rolling of more accurate plate thickness, as suggested by JP '823A.

Applicants respectfully traverse this ground for rejections. For the reasons stated herein, as well as for other reasons, it is believed that the claims as amended herein are patentable over the prior art of record.

In particular, the object solved by the present invention includes two aspects.

On the one hand changing of the work rolls of a rolling mill should be facilitated by the invention. This object is solved by the invention in that a chock with support or intermediate rolls is provided, the chock being slidable into and out of the roll stand along a longitudinal direction of said chock wherein each support or intermediate roll is associated with and supports one of said work rolls along a direction which is essentially perpendicular to a movement direction of a metal strip passing through the roll stand. For that purpose the back up rolls can be positioned via a force generation device from an idle position, in which they are arranged outside the region where the chock of the support roll or intermediate roll moves during slide-in or withdrawal, to an operating position in which the back up rolls press against the work roll. Thus, changing or servicing of the support, intermediate or work rolls is facilitated without any risk of collision with the back up rolls. At the same time the back up rolls can also be serviced or changed easily

without necessitating removal of the chock from the roll stand. These measures are known in principle from the state of the art disclosed in EP '247.

On the other hand, the invention should also enable the influencing of the roll gap between the work rolls in a more precise manner while reducing the constructional measures necessary in order to achieve this. This object is met by providing a plurality of force generation devices arranged along said back up rolls, each of the force generation devices being adjustable in such way as to provide an adjustable whipping of its respective back up roll or work roll via its support beam. In contrast to the state of the art, according to the invention the force generation devices act on support beams, which support the back up rolls fitting close to the working roll. By this measure, in a rolling stand according to the invention only a small number of force generation devices are necessary in order to achieve an evenly, free of discontinuities whipping of the back up rolls and the work rolls, and thus forming a roll gap with an equally, discontinuity free shape of precise dimensions.

This important effect achieved by the invention is illustrated by the enclosed Drawing 1, which is a schematic axial section of the roll stand according to the invention. The numerals used in this drawing correspond to the numerals indicated in the drawings of the present application. In order to simplify the understanding in Drawing 1, the deformation of the rolls and the rolling gap is shown in an enlarged manner.

In accordance with the example disclosed in Figures 1 to 3 of the application, in the enclosed Drawing 1 of the invention, seven force generation devices 20 are shown

uniformly distributed along the upper support beam 12 the force generating devices being placed at a relatively large distance from each other. The upper support 12 beam acts upon the upper backup roll 8 which in a close fit supports the upper work roll 1. In the same manner, seven force generation devices 23 are uniformly distributed along the lower support beam 14, the lower support beam acting 14 upon the lower backup roll 10 which fits closely to the lower work roll 2. Both work rolls 1,2 border the roll gap through which the metal strip to be rolled is conveyed.

The forces F generated by each force generating device 20,23 are separately adjustable. Accordingly, in order to adjust the shape of the roll gap as shown in Drawing 1 of the invention, each of the force devices 20,23 apply a different force to that support beam 12,14 to which the respective force generating device 20,23 is assigned. The support beam is a member which has a certain deforming rigidity when being loaded with forces which are applied crosswise to its longitudinal direction. This deforming rigidity causes the support beams 12,14 to be bent in an even manner. Thus, although the points at which the forces applied by the force generating devices 20,23 act on the support beams are positioned at relatively large distances, the support beam is bent in a way so that no sharp peaks of deformation exist. Accordingly, by applying the forces to the support beam the deformation which results in the appliance of the forces is flattened so that a smooth transition between each sector of the deformation is ensured.

The force generation devices 20,23 act on the support beam 12,14 initially applying a force to the support beam only in the areas of contact between the force

generation devices and the support beam. However, this initial local force applied to the support beam is evened out in the way explained above. The evened out force distribution is then transmitted by the support beam to the back up roll. In the back up roll an even force distribution results, thus causing the back up roll to bend accordingly. The bending or whipping of the back up roll is directly transmitted to the work roll, causing the work roll to bend accordingly. Even when only using three force generation devices, the force distribution in the back up roll seen along the length of the roll shows no abrupt changes or steps, accordingly leading to even and precise whipping of the work roll.

The force generation devices according to the invention act on the work roll in an indirect manner via the respective back up roll and the respective support beam. On page 2 of the Final Office Action, it is stated that the force generation devices are arranged between a support beam and the back up roll. In fact, however, the force generation devices act directly upon the support beam and only indirectly upon the back up roll and the work roll (see Figure 3 of the application and the enclosed Drawing 1).

According to the invention, in order for the whipping of the work roll and thus the roll gap to be defined precisely and evenly, it is not necessary to provide a large number of force distribution devices. Instead, by providing the support beam for evening out the force introduced by the force generation devices, only a small number of force generation devices are required which achieve even and precise whipping of the work roll without steps or other abrupt changes in the forces introduced, seen along the length of the roll.

Therefore precise definition of the roll gap and even wear of the work roll is achieved with a small number of force generation devices. The roll stand according to the invention requires less constructional measures in order to achieve a more precise and even definition of the roll gap.

Turning now to the prior art, EP '247 discloses a multi-stage rolling mill having work rolls of a small diameter and supporting rolls for supporting and driving the work rolls. According to EP '247 there is a chock provided, carrying the work rolls, which can be withdrawn from the roll stand. For this purpose the horizontal supporting roll according to EP '247 is driven away from the work roll, thus leaving enough space for secure withdrawal of the chock with the work roll. (EP '247, page 10, lines 21 et seq.)

EP '247 does not disclose a plurality of force generation devices, which force generation devices act on support beams supporting the back up rolls, wherein each of the force generation devices is adjustable in such way as to provide an adjustable whipping of its respective back up roll or work roll via its support beam, as specified in claim 21.

As discussed in a prior Amendment, according to EP '247, there are provided back-up rolls 49, 96, which are respectively borne by a support beam 54. However, the actuating cylinders 85 coupled to the support beam 54 only serve to move the support beam into operating position. As soon as this operating position is achieved, the force pressing the back-up rolls 49, 96 against the work roll is adjusted via wedges 84. These wedges are guided in a housing 42 by a spindle drive 90 and act on the lateral ends of the support beam 54. Between the wedges 84 and the support beam 54 spacer blocks 83 are

arranged. These spacer blocks 83 can be withdrawn upwards by hydraulic cylinders 87 in order to clear the space between the wedges and the respective support beam. Thus withdrawal of the support beams from the operating position into the idle position is to be simplified according to EP '247.

Therefore, according to EP '247, a hydraulic actuating cylinder is assigned to each support beam. However, these actuating devices only serve to move the respective beam from an idle position to an operating position in the case of a change of work rolls. The mentioned actuating cylinders are consequently not force generation devices in the sense of the invention, via which a support force is applied to the respective work roll. Rather, the actuating cylinders according to EP '247 are conventional actuating devices, which merely move the respective beam and the back-up roll borne by the beam.

In addition, according to the roll stand known from EP '247 in each case only two actuating devices are present, which furthermore only act on the lateral corner areas of the support beam. Even if these actuating devices would apply a support force during the rolling process, they could consequently not generate a targeted deformation of the beam and the back-up roll borne by the beam, adapted to the complex deformations of the work roll. In particular, the wedges provided according to the device described in EP '247 for generating the support force cannot be adjusted quickly. This however would be required in order to achieve a fast and precise adaptation of the load of the support beam and, respectively, of the rolls loaded by said beam to a changed operating situation.

The idea of the invention, to provide force generation devices arranged along a support beam, which force generation devices actively cause a deformation during rolling of the support beam and the back-up roll carried by same beam, is therefore not realized in the device disclosed in EP '247. Also not disclosed in EP '247 is the idea to arrange several force generation devices along the respective support beam, which in operation actively apply certain support forces to the respective support beam.

Therefore according to the roll stand known from EP '247, generation of the support force is achieved with additional wedge elements, remaining fixed during operation, which elements are not suited for a dynamic adaptation of the support force to a quickly changing operating situation. Consequently generation of the support force according to EP '247 occurs in a fundamentally different manner from the claimed invention.

Therefore, EP '247, on its own, does not render the claimed invention obvious.

JP '823A discloses a method and structure for correcting a roll gap. As can be seen from Figures 1 and 2 of JP '823A, there are provided work rolls 1, 2, intermediate rolls 7 and support rolls 6. Further, there are provided back up rolls 3, laterally supporting the work rolls. The lateral support according to JP '823A is carried out via a plurality of force generation devices ('pushing devices') 13, 15. Via piston rods 16 the force generation devices engage an axis, carrying pushing rolls 4, which pushing rolls act on the back up roll. According to JP '823A, variations of the roll gap between the work rolls are to be minimized. A removable chock carrying the work rolls is not disclosed in

JP '823A. Also not disclosed in JP '823A is the teaching of the claimed invention to retract the back up rolls for easy and secure removal of the work rolls.

Accordingly JP '823A by itself does render obvious the claimed invention.

However, even combining EP '247 with JP '823A would not lead the person skilled in the art to the claimed invention, as will be shown hereinafter.

The functioning of the roll gap control according to JP '823A is schematically shown in the enclosed Drawing 2b 'Support of work roll according to JP '823', which is a partial sectional view of the roll stand according to JP '823A parallel to the plane of conveyance of the rolled metal strip. Drawing 2b essentially corresponds to Figure 2 of JP '823A.

In Drawing 2a there is demonstrated the support of the work rolls in accordance to the invention as explained above.

For comparison, in Drawing 2b the support of the work rolls in accordance with the state of the art disclosed in JP '823A is illustrated, showing three force generation devices, which act upon the axis they are connected to via the piston rods. As in Drawing 2a, the middle device applies less force to the axis than the two outer devices. According to JP '823A, the force generation devices cause a bending of the axis, to which they are connected. Through this bending of the axis the pushing rolls transfer the force of the force generation devices upon the back up roll. Since the force is not applied to the back up roll via a support beam in the inventive manner, which support beam is made from one piece, the force is only applied to the parts of the back up roll which are abutting the

pushing rolls. Accordingly a step-like force distribution, showing abrupt changes results in the back up roll, as indicated by the arrows in Drawing 2b.

This force distribution according to JP '823A, which in contrast to the invention, is step-like with abrupt changes leads to uneven bending of the back up roll and thus also of the work roll. In order to achieve an equally even and precise bending of the back up roll and thus of the work roll as is achieved according to the invention, a large number of force generation devices would be necessary according to JP '823A. This large number of force generation devices would have to be arranged in close vicinity adjacent to each other, in order to reduce the size of the steps in the force distribution in the back up roll to an acceptable extent. It is precisely this necessity of a large number of force generation devices which is avoided according to the invention, while at the same time still solving the object of evenly and precisely adjustable whipping of the work roll. According to the invention this is achieved by providing the support beam, upon which the force generation devices act in the inventive manner. A direct comparison of Drawing 2a with Drawing 2b makes the fundamental difference between the claimed invention and the device according to JP '823A even more clear.

According to JP '823A, the force generation devices are arranged between a support beam and a back up roll. This seen most clearly in Fig. 2 of JP '823A. However, claim 21 as amended herein now specifies that "said back up rolls, said support beams and said plurality of force generation devices are aligned with each other so as to exert forces on said work rolls in line with said force generation devices." It is this inventive

feature of providing the force generation devices, the support beam, and the back up rolls in line with each other, that contributes essentially to the solution of the inventive second object, which is to influence the roll gap between the work rolls in a more precise manner while at the same time reducing the constructional measures necessary in order to achieve this, in particular to reduce the number of necessary force generation devices.

Thus, the second object of the invention is solved neither by the roll stand disclosed in EP '247, nor by the roll stand disclosed in JP '823A. Accordingly, even if the person skilled in the art would have combined the teachings of EP '247 and JP '823A he/she would still not have obtained the claimed invention. Accordingly, it is submitted that the claimed invention is patentable over the prior art of record.

Additionally, the person skilled in the art would have no motivation to combine the teachings of EP '247 and JP '823A. EP '247 addresses the object of providing a roll stand, where the work rolls can easily be changed by secure and easy removal of the chock carrying the work rolls, which is also one of the objects of the invention. This object, however, is not addressed at all in JP '823A. Accordingly it can not be seen why the person skilled in the art looking for a solution to the two mentioned inventive objects, of facilitating removal of the work rolls at the same time as improving the adjustability of work roll whipping would have transferred the set-up of the rolling stand of JP '823A, which lacks any hint towards the first object of the invention, to the roll stand according to EP '247.

With regard to claims 22-28, they all depend from claim 21 and accordingly incorporate all of the limitations contained therein by reference. Therefore, it is believed that they too are patentable over the prior art of record for similar reasons.

In view of the foregoing, it is believed that the present application is now in condition for allowance and a favorable action on the merits is respectfully requested.

Respectfully submitted,

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Enclosure: Drawing 1
Drawing 2